Recirculation Subtraction and Left-to-Right Shunt Quantitation

TO THE EDITOR: In a recent article in the *Journal*, Madsen et al. (*1*) presented an attempt to improve the Maltz-Treves algorithm of left-to-right shunt quantitation using a recirculation subtraction technique, in a semiempirical manner. Comparative performances of the standard method and the new method were assessed by correlating the output of both methods with patients' oximetry data as well as with known shunts of simulated curves.

Both methods only moderately correlated with oximetry, while the new method was superior when applied to simulation data. In order to conclude that the method of Madsen et al. is really an improvement on the standard technique, one has to assume that in the sample studied: (1) oximetry did not provide the true numbers and (2) the simulated data resembled the true curves in all aspects that are important in the quantitation procedure.

The authors did not describe their simulation methodology in sufficient detail and the latter data cannot be verified. In particular, it is not clear whether their synthetic curves contained shunt distortion related to an indicator that only traversed the shunt loop once, or whether the multiple shunting was also simulated. In the former case, the simulation results would be strongly biased, since their method was gauged on the recirculation data of normal pulmonary radiograms and therefore is not designed to deal with shunt recirculations other than the first one. The authors themselves mentioned the problem of continually shunted blood, ascribing it primarily to large shunts. This seems to be the major problem with the method.

I agree that the method proposed is more reproducible than the Maltz-Treves method, and may prove especially important in patient follow-up. However, the question of accuracy may not have been thoroughly investigated.

REFERENCE

1. Madsen MT, Argenyi E, Preslar J, Grower-McKay M, Kirchner PT. An improved method for the quantification of left-to-right cardiac shunts. *J Nucl Med* 1991;32:1808–1812.

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REPLY: We would like to thank Eterović and Dujić for their interest and comments on our paper. We have the following comments on the points they have raised.

The simulated shunt curves in our paper did not include multiple shunting and as such were somewhat biased toward the new method with respect to accuracy. However, the assertion that our method is not designed to deal with shunt recirculation because it is gauged on the recirculation data of normal pulmonary radiograms is misleading. The recirculation portion of the estimated normal curve is actually constrained to fit the observed lung time-activity curve, except when this value exceeds 25% of the maximum value of the first-pass portion. In addition, the domain over which the difference between the observed and estimated lung curves are integrated is limited to the time corresponding to the maximum in the recirculation portion of the curve. Both of these factors tend to reduce the bias of multiple shunting in estimating the QP/QS, although there may still be a tendency to overestimate large shunts as we stated in our paper (*1*).

It should be noted that the question of whether the proposed method is better than the Maltz-Treves method is not only a matter of accuracy. Other equally important issues are reproducibility and ease of use. The new method is easier to use because it eliminates the gamma variate fit of the recirculation portion of the difference curve where it is often difficult to distinguish between systemic recirculation and shunted activity. The interobserver variability of the measured QP/QS values was significantly smaller for the new method for both the simulated and patient data sets. This, as Eterović and Dujić note, is a strong advantage when evaluating a patient over a period of time.

REFERENCE

1. Madsen MT, Argenyi E, Preslar J, Grover-McKay M, Kirchner PT. An improved method for the quantification of left-to-right cardiac shunts. *J Nucl Med* 1991;32:1808–1812.

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